AD-A188 635 ELECTRONIC PROPERTIES OF SEMICONDUCTOR INVERSION LAYERS 1/1
IN SUB-MICRON STRUCTURES(U) BROWN UNIV PROVIDENCE RI
P J STILES 15 OCT 87 ARO-20644.1-EL DAAG29-84-K-0139
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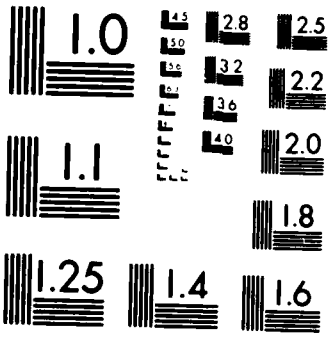

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Electronic Properties of Semiconductor Inversion Layers in Sub-Micron Structures

Final Report

AUTHOR(S)

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A summary report of research conducted under contract #DAAG29-84-K-0139 is given. This project is still in the construction phase therefore, no research results are reported. Recent results on alternatelithography techniques are shown.

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This report covers the research carried out under ARO contract #DAAG29-84-K-0139. This research was first proposed in February 1983, with subsequent ARO funding in June 1984. The contract was renewed for one more year in 1985. Two non-funded extensions carried the contract through June 1987.

The original proposal contained a research program for the fabrication and study of ultra-sub-micron structures. The centerpiece of this effort was the construction of an e-beam pattern generator capable of ultra-sub-micron resolution lithography. Our original plan was to modify an existing SEM column for this purpose, however, by the time ARO funding actually began a different approach was adopted and we decided to build a separate system based on a new Amray 100B SEM column. We severely underestimated the time, manpower, and staging requirements for this project. In addition, lack of interest in funding instrument development necessitated the use of time consuming design alternatives. Although the system has been operational for over a year, final construction of the system is still not complete. All operation to date has been to refine the system, as opposed to generating research results. Replacement of prototype components and installation of new electronics will continue through this year. We do not anticipate that the system will be used on a research basis until next spring. Funding for this work has been taken over by the university and by other research grants, at the price of additional construction delays to make the system suitable for mask fabrication for LSI circuit designs. Future research results from this work will be made available to ARO, as well as recognition and acknowledgement of ARO's contribution to them.

During the past year we have continued to pursue the other avenue of sub-micron pattern generation described in our original research proposal but which were deemphasized with the award of the ARO contract. We have designed and built our own RIE system with several unique features for etching sub-micron patterns. Using this system, we are again studying other lithographic techniques to be used in conjunction with e-beam lithography. An example of the results of this work is shown in the attached figure. This figure shows a large area periodic array of 60nm triangular holes etched into a 200 nm layer of silicon dioxide on a silicon substrate. These superlattice structures can be quickly and easily generated in large quantities at a cost of a few cents, as opposed to the low yield and high cost of strict e-beam fabrication. We are presently working on generating similar structures in GaAs heterostructures.

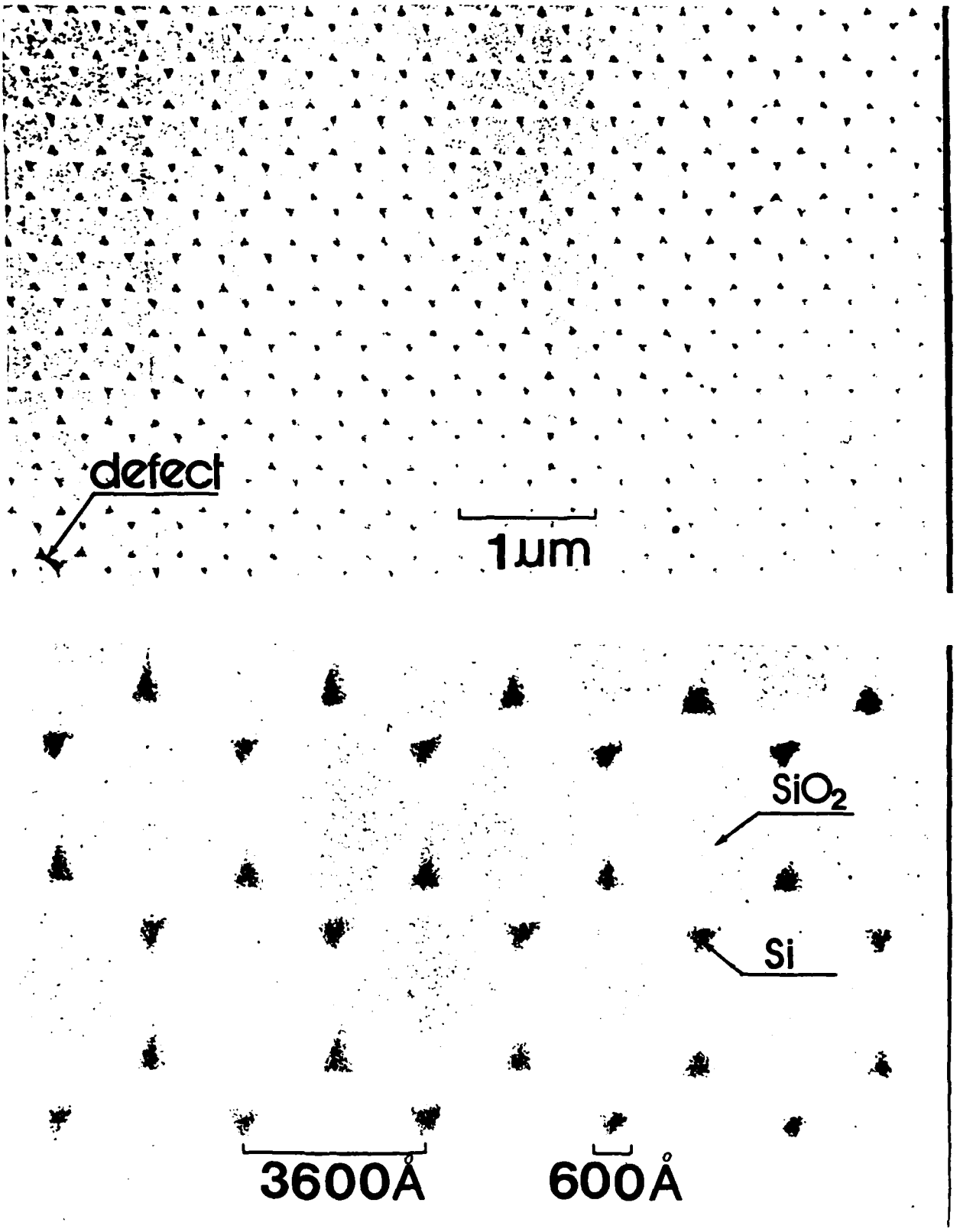

Fig. 3 : The SEM photographies of small periodic structures on a 3000 Å thermally growthed silicon dioxide layer with Si substrate and etched by RIE with the 3600 Å polystyrene sphere pattern. The defect showed on upper picture is due to a small size polystyrene sphere. The dark triangle areas on bottom picture are the close view of 600 Å size holes etched through the oxide to Si substrate.

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